



**APPENDIX TO
DEVICE AND METHOD FOR INSPECTION
OF BAGGAGE AND OTHER OBJECTS**

```
#define MIN_HI 1
#define MAX_HI 2001
#define HI_INDEX 1
```

```
#define MAX_IDX 4000
```

```
/* #define TISSUE */
#define C4
/* #define RDX */
/* #define WG */
/* #define DYN */
/* Tissue equivalent epoxy plastic */
/* C4 plastic explosive */
/* RDX sheet explosive */
/* Water Gel explosive */
/* 40% dynamite stick */
```

```
/* new way of determining low */
```

```
#define z1 .0247
#define z2 .01492
#define z3 .265
#define z4 112.6
#define z5 25.198
#define z6 .6218
#define z7 .265
```

```
/* define substance parameters */
```

```
#ifdef WG
#define c1 9.732
#define c2 6.108
#define c5 1.218
#define K0 .547
#define KL .961
#endif
```

```
#ifdef RDX
#define c1 9.732
#define c2 6.108
#define c5 1.218
#define K0 .65
#define KL .86
#endif
```

```
#ifdef C4
#define c1 9.732
#define c2 6.108
#define c5 1.218
#define K0 .6522
#define KL .87
#endif
```

```
#ifdef DYN
#define c1 570.46
#define c2 4.352
#define c5 .304
```



```
#define K0 .522
#define KL .765
#endif

#ifndef TISSUE
#define c1 3798
#define c2 3.8837
#define c5 0.993
#define K0 .655
#define KL .825
#endif

double bh(double km);
double bh(double km)
{
    return(c1*pow((km+c5),c2));
}

double Kref(double Hi,double Km,double k0);
double Kref(double Hi,double Km,double k0)
{
    return (((Hi+bh(Km))*k0*KL)/((bh(Km)*KL)+(Hi*k0)));
}

double alpha(double km);
double alpha(double km)
{
    return((z1+(z2*km)-(z2*z3))/(km*km));
}
double beta(double km);
double beta(double km)
{
    return((z4+((z6-km)*(z5/(z6-z7))))/km);
}

double newlow(double h,double km);
double newlow(double h,double km)
{
    return (h*(1/(km+alpha(km)*(h/(h+beta(km))))));
}

double find_Km(double hi,double Kair,double kref);
double find_Km(double hi,double Kair,double kref)
{
    /* find the Km that approximates the desired Kref given high val,k0 */
    int x,bitval;
    double lsbval,approx_kref;
```

```
lsbval = 0.8;
bitval = 0;

for (x=0;x<8;x++)
{
    bitval=(bitval<<1)|1;
    lsbval = lsbval/(double)2.0;

    approx_kref = (Kref(hi,((double).1+((double)bitval*lsbval)),Kair));

    if (approx_kref < kref)
        bitval=bitval&(0xfe) ;

}
return ((double)bitval*lsbval)+.1;
}

double findKm_Low(double hi,double low);
double findKm_Low(double hi,double low)
{
    /* find the Km that approximates the desired Low given high val,k0 */
    int x,bitval;
    double lsbval,approx_low;

    lsbval = 0.8;
    bitval = 0;

    for (x=0;x<8;x++)
    {
        bitval=(bitval<<1)|1;
        lsbval = lsbval/(double)2.0;

        approx_low = (Low(hi,((double).1+((double)bitval*lsbval))));

        if (approx_low < low)
            bitval=bitval&(0xfe) ;

    }
    return ((double)bitval*lsbval)+.1;
}

/* create the histogram */
for (hint = MIN_HI; hint < MAX_HI; hint += HI_INDEX)
{
    h = (double)hint;                                /* Get hi double value. */

    /* Set up the header values and the KIdx */
    Hdr[HI_VALUE] = hint;
    KIdx = 0;
```

```
/* Get the hi and lo kref */
hi_kref = Kref(h, 0.29, k0);
lo_kref = Kref(h, 0.8, k0);
k=lo_kref;

lastl = -100.0;
diff1 = 1000.0;
while (k<hi_kref)
{
    km=find_Km(h,k0,k);
    kr=Kref(h,km,k0);
    l=Low(h,km);
    if (((l-lastl)<diff1)&&(km>.29))
        diff1 = l - lastl;

    lastl = l;

    if (h>800.0)
    {
        k=k*1.04;
    } else
        k=1.01*k;           /* 1% bins */

}

/* do it again, but use diff1 to find values */
k=lo_kref;
km=find_Km(h,k0,k);
l=Low(h,km);
findl=(int)l;

/* adjust diff1 to a power of 2 */
tdiff1=0;
while ((1 << (tdiff1+1)) <= (int)diff1)
    tdiff1++;

km=findKm_Low(h,(double)findl);
k=Kref(h,km,k0);

/* Save the minimum low and the scale factor */
Hdr[MIN_LO] = findl;
Hdr[LO_SCALE] = tdiff1;

while (k < hi_kref)
{
    km=findKm_Low(h,(double)findl);
    k=Kref(h,km,k0);

    /* Save the necessary information into the values */
    KrefTab[KIdx] = (float)k;
```

```
KIdx++;

/* increment low */
findl += (1 << tdiff1);

/* increment bin count */
bincnt+=1;

}

/* Now we have the table, write out the header then the table */
Hdr[MAX_LO] = findl;
bwritten = write (fhndl, (char *)Hdr, sizeof(int)*4);
if (bwritten != (sizeof(int) * 4))
{
    printf("Error writing file\n");
    return(1);
}

/* Now write out the kref vector */
bwritten = write (fhndl, (char *)KrefTab, sizeof(float)*KIdx);
if (bwritten != (sizeof(float)*KIdx))
{
    printf("Error writing file\n");
    return(1);
}

/* output bin count */
printf("Total Kref bin count :%ld\n",bincnt);
```

```
/*
 * Detection algorithm for above histogram
 */

/*
 * Function:
 *     DoBox
 *
 * Description:
 *     Process the box.
 *
 * Usage:
 *     DoBox (x, y)
 *
 * Inputs:
 *     x - int : the x coordinate of the candidate pixel
 *     y - int : the y coordinate of the candidate pixel
 *
```

```
* Outputs:
*      None
*/
static void DoBox (int x, int y)
{
    int tx, ty;
    double diffH, diffL, diffK;
    double kreflo,krefhi,krefavg;
    /* int tmp; */
    double mindiff;
    Pixel *midpxl = &ScanLine[y][x];
    Pixel *pxl;

    /* Average the values for this pixel */
    AveragePixel (x, y);

    /* See if we need to do this pixel */
    if (midpxl->avghia > 2000.0)
        return;

    /*
     * Calculate the min difference value (this is calculated by using
     * twice the expected noise as the difference value).
     */
    mindiff = (10000.0/(100.0+midpxl->avghia));

    /* Now loop through the pixels doing the box */
    for (ty = y - BORDER; ty <= (y + BORDER); ty++)
    {
        /* Get the pixel */
        pxl = &ScanLine[ty][x - BORDER];

        /* Loop through the x */
        for (tx = x - BORDER; tx <= (x + BORDER); tx++, pxl++)
        {
            /* See if we need to look at this pixel (edges are no-nos) */
            if (pxl->sobel)
                continue;

            /* Average this sucker */
            AveragePixel (tx, ty);

            /* Now difference the Hi AIRS */
            diffH = midpxl->avghia - pxl->avghia;

            /* Now threshold it */
            if (diffH < mindiff)
                continue;

            /* Now difference the Lo AIRS */
            diffL = midpxl->avgloa - pxl->avgloa;
```

```
/* Now threshold it */
if ((diffL < mindiff) || (diffL == 0.0))
    continue;

kreflo=LookupKref(pxl->avghia,pxl->avgloa);
krefhi=LookupKref(midpxl->avghia,midpxl->avgloa);

diffK = diffH/diffL;

/* Key lookup algorithm
 * Histogram generation algorithm has been fit to this ratio
 */
krefavg=(kreflo*.8)+(.2*krefhi);

/* See if we need to histogram this point */
if ((diffK < (krefavg+(MinThreshold)))
    || (diffK >(krefavg+(MaxThreshold))))
    continue;

midpxl->histval++;
}
}

if (maxhit<midpxl->histval)
    maxhit=midpxl->histval;
if(midpxl->histval > fomThresh)
    fom += (midpxl->histval - fomThresh);

if ((midpxl->histval > 0) && (midpxl->histval <200))
    histpix[midpxl->histval]++;
}
```

PATENT

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IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant : Kristoph D. Krug et al. Art Unit: 2311
 Serial No.: 07/566,083 Examiner: G. Hayes
 Filed : August 10, 1990
 Title : DEVICE AND METHOD FOR INSPECTION OF BAGGAGE AND OTHER
 OBJECTS

Commissioner of Patents and Trademarks
 Washington, DC 20231

TELEPHONE INTERVIEW SUMMARY

This communication confirms telephone interviews between Examiner G. Hayes and Ivan D. Zitkovsky (Reg. No. P37,482) on June 30, 1993 and July 1, 1993. The Examiner is authorized to change by an Examiner's Amendment the dependency of claim 7 from a multiple dependent claim to a single dependent claim by deleting "4, 5 or" from claim 7 page 71 line 1.

To the Examiner's attention, applicants submit 8 pages of an Appendix filed with the application on August 10, 1990 and a copy of the corresponding postcard stamped by the Patent and Trademark Office and returned to Applicant.

Please apply any charges or credits to Deposit Account No. 06-1050. Applicant is a small entity based on the Small Entity Statement filed February 11, 1993.

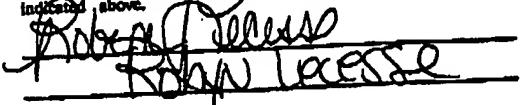
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DATE: July 1, 1993
TO: Examiner G. Hayes
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FROM: John N. Williams, Reg. No. 18,848
RE: U.S.S.N. 07/566,083
Applicant: Christoph D. Krug et al.
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